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Abstract

Process for refining a metal bath containing substantial quantities of solid cooling matter, in particular scrap metal, which provides for a refining operation through blowing of oxygen from the top on to the surface of the bath and introducing powdered carbon suspended in a neutral gas jet into the bath, said jet being directed on to the bath surface, characterized in that a velocity of the order of Mach 1.5 to Mach 2.5 is imparted to the jet and in that a quantity of neutral gas is injected simultaneously into the bath, through permeable elements lodged in the bottom of the vessel, which is sufficient to prevent foaming of the slag under the effect of the added carbon.

Description

Process and device for the refining of a metal bath containing of the cooling materials solid.

The present invention relates to a process and a device for the refining of a metal bath containing of the substantial quantities of cooling materials solid, particularly scraps.

There are several means to increase the capacity of charging of scraps during a process of refining. One can, p.ex.

to envisage a pre-heating of these scraps, which requires the carrying in work of heat sources, such as burners with gas, heavy oil or, following of the more sophisticated processes and also more expensive, burners with plasma.

Another mean consists in incorporating in the metal in process of refining of the materials capable to react with oxygen of refining with a simultaneous release of energy, particularly of carbon. The carbon introduction per submerged lance and using neutral carrying gases is a possibility which is to be drawn aside, since it is difficult to conceive an operation of this kind which would proceed so multanément with the refining. As regards the incorporation of carbon by conduits placed in the content of the converter, it is necessary to raise that in order to prevent the bloquage these conduits, it is necessary to envisage a continuous carrying gas supply, of a substantial scale, which poses problems of cooling of the molten metal. Indeed the cooling of the metal by carrying gas is not likely to support the carrying in solution of carbon in the metal, which is a clearly endothermic reaction.

One also tried to recarburize metal baths by addition of carbon by the high one. Thus FR 79.16626 described a process which provides that one blows on the surface of the bath of calcium carbide and this by using oxygen of refining like vehicle of carbide, which present a granulometry of 0,01 A 1 Misters. I1 proves that the carbide conveyed by Oxygène oxide not, which can surprise and what the authors of this document allot to the fact that the oxygen jet charged with carbide undergoes with extended of the lance a relaxation accompanied by a vigorous cooling.

The carbides are chemical compounds which one obtains by reactions consuming large quantities of energy, so that the recarburization of a metal bath operated in order to lead to benefits on the planar energetic one, should exclude the carrying in work from materials such as carbides.

I1 would be consequently logical to envisage the use of carbon in the form of anthracite, coal dust of coke or other suitable carbonaceous materials. Gold in this case it would be not very probable that lTon can operate the blowing of the manner described in the demand for patent FR 79.16626 without qu1il has there oxidation of carbon and same oxidation in the form of a vehement and destructive combustion with respect to the lance of blowing, of the system of cooling of the chimney and the coating of the crucible. In more it is necessary to envisage a very rapid foaming of slag under the effect of carbon insufflated in.liaison.with oxygen and, consequently, a risk of overflows and projections.

The purpose of the invention was thus to propose a process and an installation for the refining of metal containing of the substantial quantities of scraps and in which one creates energy required with the carrying in fusion of the solid metal by a carbon contribution, and this by avoiding on the one hand the use of carbon in an expensive form and on the other hand the awkward secondary effects like the foaming of slag during the addition.

This purpose is reached by the following process the invention which provides that one operates a refining by oxygen blowing by the high one on the surface of the bath and who is characterized in that one introduces into the bath of powdered carbon suspended in a neutral gas jet, that one directs the aforementioned jet into vertical on the surface of the bath by printing a speed about Mach 1.5 to him to 2.5 and which one injects at the same time into the bath, by permeable elements placed in the content of the crucible, a quantity of neutral gas sufficient to prevent slag from foaming under the effect of insufflated carbon.

Following the invention the blown oxygen on the surface of the bath is made up on the one hand by at least an hard jet which one directs on the bath under an angle of 5 to 200 compared to the jet carbon/neutral gas and a substantially equal speed, C. D. about Mach 1.5 to 2.5, and in addition, by at least a soft jet a speed of approximately Mach 0.8 to 1.5 and whose axis is inclined 25 to 600 compared to the axis of the hard oxygen jet. Indeed this hard jet being intended to carry out the refining itself, it is useful that it is directed on the bath under an enough reduced angle to guarantee a penetration of oxygen in the bath, while the soft jet is intended to distribute oxygen on all the surface of the bath, except for the zone of the center, to carry out the post-combustion of formed carbon monoxide during the refining by oxidation of carbon of the bath and who is released on the surface.

Thus the hard oxygen jets are laid out on both sides of the jet central, vertical, made up of carbon and neutral gas. A form of prefered execution of the following process the invention envisages 4 hard jets which form a curtain around the central jet of carburization.

With extended of the device of blowing carbon suspended in the gas jet neutral, sudden with this one a strong relaxation, which can be ensured by equipping the head of the device of nozzles presenting a converging follow-up with diverging. The speed of the jet being about Mach 2, the carbon particles are exposed between the extended one from the lance of blowing and surface of

the pendent bath approximately 0,02 dry. only; their temperature with extended is lowered. Thus the risk of a premature oxidation of carbon is substantially removed, initially thanks to neutral carrying gas and then thanks to the short exposure time and to the low temperature.

Following the invention one injects into the bath during 1 ' refining a quantity of O to 0.3 Nm3 of neutral gas per minute and ton of metal. Thus it is prevented that the strong gas outburst at the time of the impact of carbon on slag and the metal results in a formation from foam; indeed a sparkling slag would be opposed on the one hand to the penetration carbon in the bath and on the other hand the thick layer of sparkling slag would prevent the propagation towards the metal of the thermal energy created by the post-combustion of carbon monoxide above the bath.

One can indeed show qutà defect of a neutral gas injection by IE melts of the crucible, the absorptance of carbon by the metal is highly constrained. This results not only in one poor output out of solubilized carbon and at disposal to provide thermal energy in the same bath, but also in an integral combustion of carbon above it bath which can destroy the blowing plant and same the system of cooling of the chimney.

The granulometry of carbon injected is preferably such as at least 90% of the particles have a low diameter E 1 Misters.

The role of the device of blowing used in the frame of a process of refining such as it was described, is complex. Indeed the oxygen must on the one hand penetrate in the bath so that there is decarburization and must on the other hand be distributed on the bath so that there is post-combustion of released carbon monoxide. It is necessary moreover to ensure that the oxygen of post-combustion is directed on the surface of the bath of a manner such as the post-combustion of carbon monoxide is held near surface and not in upper areas where released energy would not be used for dissolving the cooling materials added, but would put in danger the same lance like optionally the system of cooling of the chimney of the crucible. In more it is necessary obviously that the lance comprises means ensuring that there can be at no moment a contact between carbon and oxygen, neither in the body of the lance, nor as far as possible on the way between the head of the lance and the surface of bath.

To provide oxygen of post-combustion, p.ex. can. to envisage an oxygen blowing subdivided in a plurality of jets covering a substantially annular zone which permanently covers the largest possible part of surface with the bath. To carry out this technical it is known to use lances which include/understand several inclined conduits compared to the axis of the lance.

As for oxygen of refining, it can be supplied by conduits which are inclined of 5-20 compared to the axis of the lance, while each conduit intended to provide oxygen of post-combustion can present an angle of inclination of 25-60 compared to the axis of the adjacent oxygen conduit of refining.

The carbon suspended in neutral gas is projected following the invention through a conduit which is laid out in the axis of the device of blowing. Thus the carbon is directed in the center of the surface of the bath, in a cold state and at a supersonic speed.

If one wants to use only one device of blowing to introduce into the bath of oxygen and carbon, it is obviously necessary to make certain provisions of prevention of accidents. Indeed blown carbon through the conduit axial of the lance, present a capacity of abrasion pronounced, same with respect to special steels.

Thus there is risk which the walls of the central conduit are spent and which there is an escape; in this case an explosion would be probable.

To avoid this, the central conduit is equipped, following the invention of a metallic sheath filled with fluid with cooling and which present a system of monitoring of the pressure. In the event of wear of the wall and rupture, the device records a loss of pressure and it transmits a suitable instruction to a system of safety, c.à D. with a switch which is integrated in the control circuit of the lance of blowing and which stops the operations for replacement of the defective part.

Other features and benefits will arise from the description of the drawings which represent the possible shape of execution of the device of following blowing the invention.

. 1 watch a cut through the head of a lance, while. 2 watch a cut through the body of the same lance.

As it appears with. 1, the central conduit includes/understands converging (10), a collar (11) and diverging (12). To obtain a fine jet with extended of the lance, it was found qutil is necessary to envisage a conduit where the converging one (10), the collar (11) and the diverging one (12) have particular dimensions.

Thus the length (H; 0-1) the diverging one (12), the length (C; 1-2) collar (11) and the length (L; 2-3) the converging one are substantial sizes, just like the diameters of inlet (D) and extended (D) of converging (read).

The behavior of the jet of carburization, essential for the success of the following process the invention, can be optimized, c.à D. that it can be assured a penetration carbon through slag in the metal bath, by the configuration of the central conduit. For that it is expected that the collar (11) present a length (C) such that it is at least the double one of its diameter (D) which is at the same time the diameter of extended of converging (10). This collar lengthened compared to the configurations of the conventional conduits of injection, brings the discounted benefits, with cnndition that the relationship between the length and the diameter of the collar is respected, with respect to concerning dimensions converging (11), according to the D/d formula = 1 + K. L/C, where the size K must be upper to 2.

In more it is necessary to consider the length (H) the diverging one (12) which must be such as the size K in the same formula where one considers the total length (C+H) collar (11) and diverging (12) following D/d = 1 + K. T (C+H), is upper to 3.5.

The configuration of the jet is thus not influenced by the scale of the section of extended of diverging (12), so that of lightweight deteriorations on the surface of the head of the following device the invention, will not affect necessarily the configuration of the jet.

In. 2 one distinguishes the conduits which lead to the conduits laid out in the head of the lance resp. who convey fluid cooling. The conduit (1) which leads to the central conduit, present a sheath (O) in which is fluid under pressure. This pressure is supervised by a suitable device of measuring, not represented which is connected to an integrated switch in the control circuit of the lance.

The fluid one of cooling, normally of water, is conveyed by the conduits (20,21).

Claims

1. Process of refining of a metal bath contenantdes impor quantities cooling material aunts solid, particularly scraps, who provides that one operates a refining by oxygen blowing by the high one on the surface of the bath and which is characterized in that one introduced into the bath of powdered carbon suspended in a jet neutral gas, which one directs the aforementioned jet into vertical on surface bath by printing to him a speed about Mach 1.5 at Mach 2.5 and that one injects at the same time into the bath, by elements permeable placed in the content of the crucible, a neutral quantity of gas sufficient to prevent slag from foaming under the effect of the bus good insufflated.

2. Following process claim 1, characterized in that oxygen blown on the surface of the bath is made up on the one hand by at least an hard jet which one directs on the bath under an angle of 5 to 20 by report/ratio with the jet neutral carbon/gas and a speed about Mach 1.5 at Mach 2.5 and in addition, by at least a soft jet of one speed of approximately Mach 0.8 at Mach 1s5 and whose axis is inclined of 25 to 60 compared to the axis of the hard oxygen jet.

3. Following process the claims 1 and 2, characterized in that one preferably lays out 4 hard jets of oxygen of refining around vertical central jet of carburization and which one provides a number equal or upper of soft oxygen jets of post-combustion.

4. Following process claims 1-3, characterized in that lton lay out the têtede the lance with a distance such with respect to surface bath, that the free journey time of carbon is of the 0.02 seconds order.

5. Following process claims 1-4, characterized in that one implements a carbonaceous material of a granulometry such as at less 90 Z of the particles have a low diameter at 1 Misters.

6. Device for the execution of the following process claims 1
5, characterized in that it includes/understands a conduit (1) central, verti
shim to convey the jet of carburization, preferably 4 conduits
(2) for oxygen of refining and an equal number or upper of
conduits (3) for oxygen of post-combustion, the conduits of affi
swim being inclined of 5-20 compared to the axis of the lance,
while the conduits for oxygen of post-combustion present
an angle of inclination of 25-600 compared to the axis of the conduit
of oxygen of refining adjacent.

7. Following device claim 6, characterized in that
present central conduit converging (10), a collar (11) and one
diverging (12), the length (C) of the collar (11) being at least the double one
of its diameter (D).

8. Following device claims 6 and 7, characterized in that
the diameter (D) of the section of inlet of converging (10),
length (L) of converging (10), the diameter (D) of the collar (11) and
length (C) of the collar (11) are bonded by the D/d formula = 1 + K. L/C,
where K is upper to 2.

9. Following device claims 6-8, characterized in that
diameter (D) of the section of inlet of converging (10), the length
(L) of converging (10), the diameter (D) of the collar (11), the length (C)
collar (11) and the length (H) of diverging (12) are bonded by
formulate D/d = 1 + K. L (C+H), where K is upper to 3.5.

10. Following device claims 6-9, characterized in that
central conduit (1), present a sheath filled of fluid and provided
of a system of monitoring of the fluid pressure of the aforesaid, which
system being connected to a switch which is integrated in
control circuit of the device.